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IMPACT OF DUST ON AIR QUALITY AND RADIATIVE FORCING : AN EPISODIC STUDY FOR THE MEGACITY ISTANBUL USING RegCM4.1

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Istanbul is a megacity (with population over 15 million) that has significant levels of Particulate Matter concentrations. It is suspected that long-range transport of Saharan dust is one of the main contributors. The purpose of this study is to investigate the relationship between high PM concentrations and dust transport using atmospheric modeling, satellite data as well as in-situ observations. Measurements of PM10 concentrations at 10 different stations in Istanbul for the period 2004-2010 were provided by the Turkish Ministry of Environment. Daily mean PM10 concentrations exceeding the European standard of 50 μg/m3 were found to be, on average, 49 days for the Spring period, 45 days for the Winter period, and 41 days for the Fall period. DREAM model output (Nickovic et al. 2001; Perez et al. 2006) suggests that high PM10 concentrations correlate highly with mineral dust transport episodes from Saharan desert (i.e. 23% for winter and 58% for spring).

In this study, we have utilized RegCM4.1 model to further investigate the Saharan dust transport in the selected episodes. During the period between March 21st and 24th, 2008, observed daily mean of PM10 concentrations reach up to 140 μg/m3 in Istanbul. Simulations conducted by RegCM4.1 provides AOD (350-640 nm model band) values ranging between 0.04 and 0.98during this episode. Central Anatolia is affected from the dust transport on 21 and 22 March 2008, with a daily mean AOD of 0.9. On 23th March 2008, the dust plume reaches the Marmara Sea and AOD increases about 1.0 over the region according to both DREAM and RegCM4.1 model outputs. On the fourth day of the episode, the dust event stops and AOD decreases to 0.5 over the region. Asymmetry parameters can be seen as 0.62 during the dust episode, while single scattering albedo is about 0.93 during the entire dust episode over Istanbul. The effect of the dust episode on the regional radiative budget over Istanbul was also estimated. Model results indicate a daily aerosol shortwave direct forcing at the surface of about -9.3, -1.7, -68.1, -16.2 W/m2. The associated TOA direct forcing is lower -5.4, -1.0, -27.9, -8.8 W/m2 , indicating that an important part of solar radiations are absorbed within the dust plume. Finally, the aerosol direct longwave forcing at the surface is 0.93, 0.20, 7.80, 3.43 W/m2 during the episode and 0.50, 0.07, 4.78, 0.68 W/m2 at TOA. These results prove that the transport of Saharan dust occurring in the Anatolian peninsula has significant impact on air quality of Istanbul and on direct radiative forcing. This paper will present the details of this analysis as well as model performance conducted with measurements from the AERONET network and MODIS, OMI and MISR satellite retrievals.